A10.2:I74

Issued July 6, 1909.

U.S. DEPT. OF AGRICULTURE
DOCUMENTS DEPT.
U.S. DEPOSITORY

United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS,

A. C. TRUE, Director.

ORGANIZATION, WORK, AND PUBLICATIONS OF IRRIGATION INVESTIGATIONS.

STAFF.

SAMUEL FORTIER, Chief.

R. P. TEELE, Editorial Assistant and Acting Chief in absence of the Chief.

IRRIGATION ENGINEERS AND IRRIGATION MANAGERS.

A. P. STOVER, Irrigation Engineer, in charge of work in Oregon.

C. E. TAIT, Irrigation Engineer, in charge of work in Imperial Valley and Arizona.

F. W. ROEDING, Irrigation Manager, in charge of work in California.

S. O. JAYNE, Irrigation Manager, in charge of work in Washington.

W. W. MCLAUGHLIN, Irrigation Engineer, in charge of work in Utah.

P. E. FULLER, Irrigation Engineer, in charge of power investigations.

O. W. BRYANT, Irrigation Manager, in charge of work in Colorado and Wyoming.

W. L. ROCKWELL, Irrigation Manager, in charge of work in Texas.

MILO B. WILLIAMS, Irrigation Engineer, in charge of work in humid sections.

DON H. BARKS, Irrigation Engineer, in charge of work in Idaho.

F. L. BIXBY, Office Engineer.

V. M. CONE, Irrigation Engineer.

C. G. HASKELL, Irrigation Engineer.

COLLABORATORS.

O. V. P. STOUT, University of Nebraska, in charge of work in Nebraska.

BURTON P. FLEMING, New Mexico Agricultural College, in charge of work in New Mexico.

GORDON H. TRUE, University of Nevada, in charge of work in Nevada.

W. B. GREGORY, Tulane University of Louisiana, in charge of rice irrigation in Louisiana and Texas.

J. T. FITTERER, University of Wyoming, studies of duty of water in Wyoming.

IRRIGATION FARMERS.

JOHN H. GORDON, R. G. HEMPHILL, W. H. LAUCK, R. E. MAHONEY, and JOHN KRALL, Jr.

SCOPE OF THE WORK.

The Irrigation Investigations of the Office of Experiment Stations are governed by the following clause of the act making appropriation for the U. S. Department of Agriculture for the year ending June 30, 1910.

IRRIGATION INVESTIGATIONS.—To enable the Secretary of Agriculture to investigate and report upon the laws of the States and Territories as affecting irrigation and the rights of appropriators and of riparian proprietors and institutions relating to irrigation and upon the use of irrigation waters, at home and abroad,

with especial suggestions of the best methods for the utilization of irrigation waters in agriculture, and upon the use of different kinds of power and appliances for irrigation, and for the preparation and illustration of reports and bulletins on irrigation, including rent and the employment of labor in the city of Washington or elsewhere, and all necessary expenses, seventy-five thousand dollars.

The purpose of the Irrigation Investigations is a better use of the water supply in those sections of the country where irrigation is practiced. The work is divided into three general classes:

(1) The study of the adaptation of the laws and other institutions governing the use of water to the needs of the agricultural industry.

(2) Scientific and technical investigations of losses of irrigation water by evaporation, seepage, and in distribution; of the relation of irrigation to the quantity and quality of crops; of the adaptation of methods of applying water to soils and crops; and of the measurement, distribution, storage, and pumping of water for irrigation.

(3) The collecting and publishing of practical information regarding irrigation practice.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS RELATING TO IRRIGATION.

[Corrected to July 1, 1909.]

The Farmers' Bulletins in the following list are for free distribution. The publications marked with an asterisk (*) can not be furnished from this Office, but may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., by payment of the price given; postage stamps and personal checks are not accepted. The bulletins and circulars of this Office not marked with the asterisk will be furnished free, so long as they are available, to libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as are in active cooperation with the Department or render tangible service in its work. Other persons can obtain these from the Superintendent of Documents.

FARMERS' BULLETINS.

Farmers' Bulletin No. 116.—Irrigation in Fruit Growing. By E. J. Wickson, M. A., Professor of Agricultural Practice, University of California, and Horticulturist of the California Experiment Station. Pp. 48, figs. 8.

A statement of the relations of irrigation to fruit production, and of irrigation methods as they have been demonstrated by Pacific coast experience.

Farmers' Bulletin No. 138.—Irrigation in Field and Garden. By E. J. Wickson, M. A. Pp. 40, figs. 18.

This bulletin discusses the subject from the standpoint of the individual farmer, and contains instructions on the determination of ditch levels, the measurement of small streams, sources of water supply and their use, the distribution of irrigation water, methods of applying water, the choice of an irrigation method, and the time for the application of water.

Farmers' Bulletin No. 158.—How to Build Small Irrigation Ditches. By C. T. Johnston and J. D. Stannard, Assistants in Irrigation Investigations, Office of Experiment Stations. Pp. 28, figs. 9.

This is a reprint of an article in the Yearbook of the Department of Agriculture for 1900, entitled "Practical Irrigation," giving methods for laying out and building small irrigating ditches, using only such implements as are found on most farms or can easily be made by the farmer.

Farmers' Bulletin No. 263.—Practical Information for Beginners in Irrigation. By S. Fortier. Pp. 40, figs. 25.

This gives suggestions as to the selection of an irrigated farm, the acquirement of a water right, the preparation of land for irrigation, the construction of farm ditches, and the application of water to crops.

Farmers' Bulletin No. 277.—The Use of Alcohol and Gasoline in Farm Engines. By C. E. Lucke and S. M. Woodward. Pp. 40, figs. 12.

This gives the general results of experiments in the use of alcohol in the ordinary internal combustion engines on the American market, with some discussion of foreign experiments.

BULLETINS.

*Bulletin No. 36.—Notes on Irrigation in Connecticut and New Jersey. By C. S. Phelps, B. S., and Edward B. Voorhees, M. A. Pp. 64, figs. 7. Price 5 cents.

This bulletin discusses the need, methods, and history of irrigation in Connecticut, irrigation plants in use in Connecticut, experiments on the effect of irrigation on strawberries, and suggestions regarding irrigation; the need of irrigation in New Jersey; amount of water necessary, storage of water, seepage, cost of irrigation, areas capable of being watered by gravity, irrigation by pumping, irrigation by wells, warping, water meadows, total area irrigable, estimated cost of irrigation and suggestions for small plants, use of irrigation in New Jersey, possibility of pumping large quantities of water from wells for irrigating purposes, and irrigation experiments in New Jersey.

*Bulletin No. 58.—Water Rights on the Missouri River and its Tributaries. By Elwood Mead, State Engineer of Wyoming. With papers on the Water Laws of Colorado, by John E. Field, State Engineer; and of Nebraska, by J. M. Wilson, State Engineer. Pp. 80, maps 3, figs. 4. Price 10 cents.

A discussion of the irrigation laws which control the diversion and use of water from the Missouri River and its tributaries. The region covered in this discussion includes Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Wyoming, and the Northwest Territories of Canada.

*Bulletin No. 60.—Abstract of Laws for Acquiring Titles to Water from the Missouri River and its Tributaries, with the Legal Forms in Use. Compiled by Elwood Mead, State Engineer of Wyoming. Pp. 77. Price 10 cents.

Includes abstracts of laws and legal forms in use in Colorado, Kansas, Montana, Nebraska, South Dakota, Wyoming, and the Northwest Territories of Canada.

Bulletin No. 70.—Water-right Problems of Bear River. By Clarence T. Johnston and Joseph A. Breckons. Pp. 40, pls. 9. Price 15 cents.

Presents some of the water-right complications of interstate streams as illustrated on Bear River. The bulletin discusses the water supply of the river and its diversion, the controversies which have arisen regarding water rights, and the need of uniform laws.

*Bulletin No. 73.—Irrigation in the Rocky Mountain States. By J. C. Ulrich. Pp. 64, pls. 10. Price 10 cents.

Explains the agricultural conditions prevailing and the methods of acquiring

and using water for irrigation practiced in that portion of the arid region covered more particularly by the States of Colorado, Wyoming, Utah, Idaho, and Montana, in which the conditions and methods are somewhat similar.

*Bulletin No. 81.—The Use of Water in Irrigation in Wyoming and its Relation to the Ownership and Distribution of the Natural Supply. By B. C. Buffum, M. S., Professor of Agriculture and Horticulture, University of Wyoming, and Vice-Director of Wyoming Agricultural Experiment Station. Pp. 56, pls. 8. Price 10 cents.

This bulletin reports experiments on the duty of water for different crops in Wyoming, and discusses the application and measurements of water, conditions affecting duty, and continuous flow as a basis of appropriation.

*Bulletin No. 86.—The Use of Water in Irrigation. Report of Investigations made in 1899, under the supervision of Elwood Mead, Expert in Charge, and C. T. Johnston, Assistant. Pp. 253, pls. 50, figs. 18. Price 30 cents.

This bulletin explains the methods in use in the arid States in the distribution and use of water in irrigation. It gives a large number of measurements made to determine the duty of water and the losses by seepage and evaporation from canals, and discusses the methods by which the water supply may be more effectively and economically utilized in the production of crops. Separates of the different articles of this bulletin have been reprinted as follows:

Part 1. Discussion of Investigations, by Elwood Mead. Computation of Discharge Records and Preparation of Diagrams, by C. T. Johnston.

*Part 2. Use of Water in Irrigation in Texas. Use of Water in Irrigation in the Pecos Valley, New Mexico, by W. M. Reed. Use of Water in Irrigation in Arizona, by W. H. Code. Duty of Water under Gage Canal, Riverside, Cal., by W. Irving.

*Part 3. Duty of Water in Nebraska, by O. V. P. Stout. Duty of Water under the Amity Canal, Arkansas River, Colorado, by Thomas Berry. Duty of Water in Wyoming, by C. T. Johnston. Duty of Water in Gallatin Valley, Montana, by Samuel Fortier. Duty of Water on Big Cottonwood Creek, Utah, by R. C. Gemmell. Duty of Water under the Logan and Richmond Canal, Logan River, Utah, by George L. Swendsen. Duty of Water as Related to the Irrigation Problems of the Boise Valley, Idaho, by D. W. Ross.

*Bulletin No. 87.—Irrigation in New Jersey. By Edward B. Voorhees, M. A., Director, New Jersey Agricultural Experiment Stations, and Professor of Agriculture, Rutgers College. Pp. 40, figs. 5. Price 5 cents.

Results of experiments conducted for the purpose of determining whether irrigation during short periods of drought in regions where the rainfall is usually sufficient for the maximum growth of crops will sufficiently increase the yield to pay for the works necessary to obtain the supply of water.

*Bulletin No. 90.—Irrigation in Hawaii. By Walter Maxwell, Ph. D., Director and Chief Chemist, Hawaiian Experiment Station. Pp. 48, pls. 6, figs. 3. Price 10 cents.

Discusses the climatic, soil, and other conditions as affecting irrigation in Hawaii, and gives the results of irrigation experiments, especially with sugar cane, carried on by the author for a number of years.

*Bulletin No. 92.—The Reservoir System of the Cache la Poudre Valley. By E. S. Nettleton. Pp. 48, pls. 14. Price 15 cents.

A description of the reservoir system of the Cache la Poudre Valley, showing the benefits to be derived from the construction of reservoirs for the storage of water for irrigation.

*Bulletin No. 96.—Irrigation Laws of the Northwest Territories of Canada and Wyoming, with discussions by J. S. Dennis, Deputy Commissioner of Public Works, Canada, and Fred Bond, State

Engineer of Wyoming, and J. M. Wilson, Agent and Expert, Irrigation Investigations Office of Experiment Stations. Pp. 90, frontispiece, pls. 5. Price 10 cents.

Texts of the irrigation laws of the Northwest Territories of Canada and Wyoming, with the regulations, forms, and methods of procedure adopted in the administration of these laws, and a discussion of the principles underlying the laws and methods followed in their enforcement.

*Bulletin No. 100.—Report of Irrigation Investigations in California, under the direction of Elwood Mead, Expert in Charge. Pp. 411, pls. 29, figs. 16. Price, paper, 90 cents; cloth, $1.25.

This report deals with investigations carried on during the summer of 1900 in cooperation with the California Water and Forest Association. In addition to a review of the agricultural situation in the State, it presents a comprehensive discussion of the water laws and customs under which irrigation is practiced in California as typified by the conditions in Honey Lake Basin, and on Yuba River, Cache Creek, Salinas River, San Joaquin River, Kings River, Los Angeles River, and San Jacinto River. Separates of the different articles of this report have been printed, as follows:

Doc. No. 448.—The Agricultural Situation in California, by Elwood Mead. *Doc. No. 449.—The Irrigation Problems of Honey Lake Basin, California, by William E. Smythe. * Doc. No. 450.—Features and Water Rights of Yuba River, California, by Marsden Manson. * Doc. No. 451.—Irrigation Investigations on Cache Creek, by J. M. Wilson. * Doc. No. 452.—Report on Irrigation Problems in the Salinas Valley, by C. D. Marx. * Doc. No. 453.—Irrigation from the San Joaquin River, by Frank Soulé. * Doc. No. 454.—Water Appropriation from Kings River, by C. E. Grunsky. Doc. No. 455.—A Study of Water Rights on the Los Angeles River, California, by Edward M. Boggs. * Doc. No. 456.—Problems of Water Storage on Torrential Streams of California as Typified by Sweetwater and San Jacinto Rivers, by James D. Schuyler.

*Bulletin No. 104.—Report of Irrigation Investigations for 1900, under the supervision of Elwood Mead, Expert in Charge of Irrigation Investigations. Pp. 334, pls. 25, figs. 29. Price 50 cents.

This report covers the second year of investigations relating especially to the duty of water. The reports of the field agents contain also a large amount of information on laws and customs, agricultural methods, crop returns, and other subjects related to irrigation. A progress report on the quantities of silt carried by a number of southern rivers is also contained in this volume. The report has been reprinted in separates, as follows:

Part 1. Review of the Work, by Elwood Mead. Discussion of Investigations, by C. T. Johnston.

Part 2. Irrigation from Pecos River and its Tributaries, New Mexico, by W. M. Reed. Irrigation in the Salt River Valley, Arizona, by W. H. Code. Duty of Water under the Gage Canal, Riverside, Cal., 1900, by W. Irving.

Part 3. Irrigation Investigations in Nevada, by J. M. Wilson. Water Administration in Utah, by R. C. Gemmell. Irrigation under Canals from Logan River, Utah, by George L. Swendsen. Irrigation under the Great Eastern Canal, Platte County, Nebr., 1900, by O. V. P. Stout. Use of Water in Irrigation at Wheatland, Wyo., by C. T. Johnston. Duty of Water in Idaho, by D. W. Ross.

Part 4. Use of Water in Irrigation in the Yakima Valley, Washington, by O. L. Waller. Irrigation Investigations in Montana, 1900, by Samuel Fortier. Progress Report on Silt Measurements, Texas, by J. C. Nagle.

*Bulletin No. 105.—Irrigation in the United States. Testimony of Elwood Mead, Irrigation Expert in Charge, before the United States Industrial Commission, June 11 and 12, 1901. Pp. 47, pls. 12, fig. 1. Price 15 cents.

The statement made before the Industrial Commission deals chiefly with the legal status of irrigation, touching on State control, national aid to irrigation, and the disposal of the public grazing lands. The necessity and possibility of storage are also discussed.

Bulletin No. 108.—Irrigation Practice Among Fruit Growers on the Pacific Coast. By E. J. Wickson, M. A., Professor of Agricultural Practice, University of California, and Horticulturist of the California Agricultural Experiment Station. Pp. 54, pls. 10, figs. 7. Price 15 cents.

This bulletin gives the results of a special investigation into the conditions, extent, and methods of irrigation as practiced among fruit growers of the Pacific coast.

*Bulletin No. 113.—Irrigation of Rice in the United States. By Frank Bond and George H. Keeney, Agents and Experts, Irrigation Investigations, under the direction of Elwood Mead, Expert in Charge of Irrigation Investigations. Pp. 77, pls. 28, figs. 10. Price 10 cents.

In this bulletin Mr. Bond describes the rice industry of Louisiana and Texas and gives measurements of the quantities of water used in irrigating rice. The laws relating to irrigation of the two States dealt with are also discussed. Mr. Keeney's report covers North Carolina, South Carolina, and Georgia, and is almost wholly descriptive.

Bulletin No. 118.—Irrigation from Big Thompson River. By John E. Field, Assistant State Engineer of Colorado. Pp. 75, pls. 5, fig. 1. Price 10 cents.

This is a study of the water laws of Colorado as illustrated by irrigation from Big Thompson River. Mr. Field discusses more particularly the "water loaning" law.

*Bulletin No. 119.—Report of Irrigation Investigations for 1901, under the direction of Elwood Mead, Chief of Irrigation Investigations. Pp. 401, pls. 64, figs. 12. Price 50 cents.

This is the third of the annual reports of the Irrigation Investigations of this Office. It deals chiefly with the duty of water, but contains also reports from four stations in the humid States, where irrigation is not a necessity, but a means of increasing the returns from farm lands; a report on the underground water supply of the San Bernardino Valley, California, and the second progress report on silt measurements. This report has been reprinted in four parts in the form of separates, as follows:

Part 1. Summary of Results, by R. P. Teele. Irrigation in New Mexico, by W. M. Reed. Irrigation Investigations in Salt River Valley, Arizona, by W. H. Code. Irrigation at the Arizona Experiment Station Farm, by A. J. McClatchie.

Part 2. Subterranean Water Supply of the San Bernardino Valley, California, by E. W. Hilgard. Duty of Water under Gage Canal, Riverside, Cal., by W. Irving. Use of Water in Irrigation in Washington, by O. L. Waller.

Part 3. The Distribution of Water from Canals in Idaho, by D. W. Ross. Investigations in Montana, 1901, by Samuel Fortier. Irrigation in Bear River Valley, Utah, by Arthur P. Stover. Irrigation in Grand and Arkansas Valleys, Colorado, by Arthur P. Stover.

Part 4. Irrigation under the Great Eastern Canal, Loup River, Nebraska, by O. V. P. Stout. Irrigation at the Missouri State Experiment Station, by H. J. Waters. Irrigation Experiments in Wisconsin, 1901, by F. H. King. Irrigation in New Jersey, 1901, by E. B. Voorhees. Second Progress Report on Silt Measurements, Texas, by J. C. Nagle.

Bulletin No. 124.—Report of Irrigation Investigations in Utah, under the direction of Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Including General Discussion of Irrigation in Utah, and Irrigation from Jordan River, by R. P. Teele; Irrigation in Utah Lake Drainage System, by A. P. Stover; The Spanish Fork River Irrigation System, by A. F. Doremus; Irrigation in the Weber Valley, by Jay D. Stannard; Agriculture under Irrigation in the Basin of Virgin River, and Court Adjudications of Water Rights on Sevier River, by Frank Adams; and Appropriations of Water from Logan River, by George L. Swendsen. Pp. 330, pls. 19, figs. 2. Price $1.10.

A detailed study of the irrigation laws, institutions, and practice of Utah.

*Bulletin No. 130.—Egyptian Irrigation. By Clarence T. Johnston, Assistant Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 100, pls. 24, figs. 9. Price 30 cents.

This is a study of the irrigation laws and practices in Egypt, made with special reference to suggestions for improvements in American irrigation.

*Bulletin No. 131.—Plans of Structures in Use on Irrigation Canals in the United States, prepared under the direction of Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 51, pls. 22. Price 60 cents.

This is an album of plans for irrigation structures, designed by leading irrigation engineers of the West, made from drawings exhibited at Paris in 1900 and at Buffalo in 1901.

*Bulletin No. 133.—Report of Irrigation Investigations for 1902, under the direction of Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 266, pls. 12, figs. 16. Price 25 cents.

This bulletin gives the result of the fourth season's investigations of the problems of irrigation, the results obtained in similar investigations in previous years being reported in Bulletins 86, 104, and 119 of this Office, noted above. This bulletin has been reprinted in three parts as separates, as follows:

Part 1. Irrigation in Mountain Water District, Salt Lake County, Utah, by E. R. Morgan. The Use of Water from the Wood Rivers, Idaho, by J. D. Stannard.

Part 2. Irrigation Investigations on Sand Creek, Wyoming, by B. P. Fleming. Irrigation in Washington, by O. L. Waller. Irrigation Investigations in Montana, 1902, by S. Fortier. Irrigation Systems on Stony Creek, California, by W. T. Clarke and C. W. Landis. Irrigation in the Black Hills, South Dakota, by A. B. Crane.

*Part 3. Rice Irrigation in Louisiana and Texas, by Frank Bond. Third Progress Report on Silt Measurements, Texas, by J. C. Nagle. Irrigation Experiments at the Missouri Experiment Station, by H. J. Waters. Irrigation in Wisconsin in 1902, by A. R. Whitson. Irrigation Investigations in New Jersey, 1902, by E. B. Voorhees. The Use of Pumps for Irrigation in Hawaii, by Jared G. Smith.

Bulletin No. 134.—Storage of Water on Cache la Poudre and Big Thompson Rivers. By C. E. Tait, Assistant in Irrigation Investigations, Office of Experiment Stations. Pp. 100, pls. 5, figs. 10. Price 10 cents.

This bulletin gives details of areas, capacities, and construction of reservoirs in northern Colorado, and the profits from their use.

*Bulletin No. 140.—Acquirement of Water Rights in the Arkansas Valley, Colorado. By J. S. Greene, ex-State Engineer of Colorado. Pp. 83, pl. 1, fig. 1. Price 5 cents.

This bulletin discusses the water laws of Colorado and the provisions of water-right contracts in relation to the physical conditions of the Arkansas Valley of Colorado. It is intended to give settlers an understanding of the points which should be looked into before they take steps toward acquiring water rights. It is also believed to be of value to students of irrigation institutions.

*Bulletin No. 144.—Irrigation in Northern Italy—Part I. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 100, frontispiece, pls. 17, figs. 14. Price 20 cents.

This is the first of three bulletins to be published giving the results of a study of Italian irrigation practice, laws, and institutions. The study was made solely from the standpoint of getting suggestions for improvements in our American systems, and it was found that we could learn much from Italy. The first bulletin contains reports on irrigation in Lombardy and Piedmont. (See also Bulletins 190 and 192.)

*Bulletin No. 145.—Preparing Land for Irrigation and Methods of Applying Water. Prepared by the Agents of Irrigation Investigations. Pp. 84, pls. 7, figs. 33. Price 15 cents.

This bulletin gives descriptions of methods of removing sagebrush, of smoothing land, of laying out fields for different systems of applying water, and of the different systems of applying water. The various methods are compared as to cost and efficiency.

*Bulletin No. 146.—Current Wheels: Their Use in Lifting Water for Irrigation. Prepared in the Office of Experiment Stations, Irrigation Investigations. Pp. 38, pls. 4, figs. 21. Price 10 cents.

Drawings and photographs of a large number of wheels used for raising water from streams are given, accompanied by descriptions, statements of cost, and discussions of efficiency. A general discussion of the theory of current wheels is also given.

Bulletin No. 148.—Report on Irrigation Investigations in Humid Sections of the United States in 1903, under the direction of Elwood Mead, Chief of Irrigation Investigations. Pp. 45, pls. 3. Price 10 cents.

This bulletin contains descriptions of several irrigation plants in market gardens near the large eastern cities, and reports of experiments with irrigation in New Jersey and Missouri; also a report on irrigation in the artesian basin of South Dakota.

Bulletin No. 157.—Water Rights on Interstate Streams: The Platte River and Tributaries. By R. P. Teele and Elwood Mead. Pp. 118, pls. 4, figs. 3. Price 10 cents.

The Platte River and its tributaries lie within three States—Colorado, Wyoming, and Nebraska. The one source of supply is therefore subject to the laws of three States. This report is a discussion of the rights to water from this source of supply, as they have arisen under the laws and physical conditions in the three States. Mr. Teele gives the results of the field work and Doctor Mead a general discussion of water laws. These have been printed as separates, which are available for distribution.

*Bulletin No. 158.—Annual Report of Irrigation and Drainage Investigations, under the direction of Elwood Mead, Chief of Irrigation and Drainage Investigations, Office of Experiment Stations. Pp. 755, pls. 12, figs. 129.

This is the general report of Irrigation and Drainage Investigations in 1904. The complete report was issued in limited edition, which is now exhausted, but it has been reprinted in form of nine separates for free distribution, as follows:

Separate No. 1. Review of the Irrigation Work of the Year 1904, by R. P. Teele.

*Separate No. 2. Irrigation in Santa Clara Valley, California, by S. Fortier. Mechanical Tests of Pumping Plants Used for Irrigation, by J. N. Le Conte.

Separate No. 3. The Distribution and Use of Water in Modesto and Turlock Irrigation Districts, California, by Frank Adams. Relation of Irrigation to Yield, Size, Quality, and Commercial Suitability of Fruits, by E. J. Wickson, Irrigation Conditions in Imperial Valley, California, by J. E. Roadhouse.

*Separate No. 4. Irrigation in Klamath County, Oreg., by F. L. Kent. Irrigation Investigations in the Yakima Valley, Washington, by O. L. Waller. Irrigation Conditions in Raft River Water District, Idaho, 1904, by W. F. Bartlett.

Separate No. 5. Irrigation Investigations at New Mexico Experiment Station, Mesilla Park, 1904, by J. J. Vernon. Irrigation Investigations in Western Texas, by Harvey Culbertson. Pumping Plants in Texas, by C. E. Tait.

Separate No. 6. Irrigation in Southern Texas, by Aug. J. Bowie, jr.

*Separate No. 7. Rice Irrigation in Louisiana and Texas in 1903 and 1904, by W. B. Gregory. Rice Irrigation on the Prairie Land of Arkansas, by C. E. Tait.

*Separate No. 8. Irrigation Experiments at Fort Hays, Kans., 1903 and 1904, by J. G. Haney. Irrigation near Garden City, Kans., 1904, by A. B. Col-

lins and A. E. Wright. Pumping Plants in Colorado, Nebraska, and Kansas, by O. V. P. Stout. Irrigation near Rockyford, Colo., 1904, by A. E. Wright. The Irrigation and Drainage of Cranberry Marshes in Wisconsin, by A. R. Whitson.
Separate No. 9. Drainage.

Bulletin No. 167.—Irrigation in the North Atlantic States. By Aug. J. Bowie, jr. Pp. 50, figs. 7. Price 10 cents.

This report contains descriptions of a large number of small irrigation plants in Maryland, Pennsylvania, New Jersey, New York, Rhode Island, and Massachusetts.

Bulletin No. 168.—The State Engineer and His Relation to Irrigation. By R. P. Teele, Expert in Irrigation Institutions, Irrigation Investigations, Office of Experiment Stations. Pp. 99, fig. 1. Price 15 cents.

In the arid region of the United States, whatever there is of public control over the use of water in irrigation is centered in the office of State engineer in the various States. This bulletin discusses the whole subject of public control of the use of water, sketching the history of such control in the various States and giving its present status and efficiency.

Bulletin No. 172.—Irrigation in Montana. By Samuel Fortier, assisted by A. P. Stover and J. S. Baker. Pp. 100, figs. 18. Price 15 cents.

This bulletin is the result of a study of typical sections of Montana, made for the purpose of determining the status and possibilities of irrigation in that State. It covers ditch construction, agricultural practice, ditch management, seepage losses, return seepage, and public control of streams.

Bulletin No. 177.—Evaporation Losses in Irrigation and Water Requirements of Crops. By S. Fortier. Pp. 64, pls. 2, figs. 19. Price 10 cents.

This contains the results of tank experiments to determine the quantities of water evaporated from soils which receive various cultural treatments and to which the water was applied at different depths; it contains also a few experiments on the quantities of water consumed by plants.

Bulletin No. 179.—Small Reservoirs in Wyoming, Montana, and South Dakota. By F. C. Herrmann. Pp. 100, pls. 8, figs. 13. Price 20 cents.

This bulletin contains the description of a number of reservoirs which have been built on the plans for storage of storm waters for irrigation and for stock water. It describes methods of construction and gives costs and returns from the use of water.

Bulletin No. 181.—Mechanical Tests of Pumping Plants in California. By J. N. Le Conte and C. E. Tait. Pp. 72, figs. 4. Price 10 cents.

This gives the results of tests of a large number of pumping plants in use for irrigation in southern California.

Bulletin No. 183.—Mechanical Tests of Pumps and Pumping Plants Used for Irrigation and Drainage in Louisiana in 1905 and 1906. By W. B. Gregory. Pp. 72, figs. 4. Price 15 cents.

This contains the results of tests of a number of the large pumping plants in use in Louisiana. These are among the largest pumps used for irrigation in the United States, and in general they use crude oil for fuel, making the tests of especial interest on account of these unusual conditions.

Bulletin No. 188.—Irrigation in the Yakima Valley, Washington. By S. O. Jayne. Pp. 89, pls. 2, figs. 4. Price 15 cents.

This bulletin describes the irrigation works in the Yakima Valley, Washington, and discusses the water supply, water rights, crops, and opportunities for settlement.

Bulletin No. 190.—Irrigation in Northern Italy—Part II. By Elwood Mead. Pp. 86, pls. 4, figs. 2. Price 15 cents.

Part I of this report is Office of Experiment Stations Bulletin No. 144. Part II covers the section watered by the Adda and Adige rivers, and deals especially with the operation of irrigation laws, and the organization for the operation of irrigation works.

Bulletin No. 191.—Tests of Internal Combustion Engines on Alcohol Fuel. By C. E. Lucke and S. M. Woodward. Pp. 89, pls. 20, figs. 13. Price 20 cents.

This bulletin gives the detailed results of tests of alcohol fuel in internal combustion engines made for the use of gasoline and kerosene.

Bulletin No. 192.—Irrigation and Drainage Laws of Italy. Translated by R. P. Teele. Pp. 100. Price 15 cents.

This bulletin contains the texts of the general irrigation and drainage laws of Italy and the regulations for putting them into effect.

Bulletin No. 201.—Cost of Pumping from Wells for the Irrigation of Rice in Louisiana and Arkansas. By W. B. Gregory. Pp. 39, figs. 2. Price 10 cents.

This bulletin contains descriptions of a number of the smaller pumping plants used in securing a supply of water for rice irrigation, with tests of fuel consumption, to determine the cost of such supplies.

Bulletin No. 203.—Distribution of Water in the Soil in Furrow Irrigation. By R. H. Loughridge. Pp. 63, figs. 19. Price 10 cents.

This bulletin contains the results of experiments to trace the water applied to orchard soils in irrigation to determine how large a part of the water used remains in the root zone of the trees and how much percolates beyond their reach.

Bulletin No. 205.—Irrigation in Wyoming. By Clarence T. Johnston, State Engineer. Pp. 60, pls. 3, figs. 22. Price 15 cents.

This bulletin is one of a series on irrigation in the several arid States, published for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

Bulletin No. 207.—Irrigation in the Sacramento Valley, California. By Samuel Fortier, assisted by O. W. Bryant, J. E. Roadhouse, A. E. Wright, and J. H. Barber. Pp. 99. Price 15 cents.

This bulletin describes the Sacramento Valley, and discusses the problems of its reclamation.

Bulletin No. 209.—Irrigation in Oregon. By John H. Lewis, State Engineer, assisted by P. A. Cupper. Pp. 67. Price 15 cents.

This bulletin is one of a series on irrigation in the several arid States, published for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

Bulletin No. 210.—Irrigation in South Dakota. By Samuel H. Lea, State Engineer. Pp. 60. Price 10 cents.

This bulletin is one of a series on irrigation in the several arid States, published for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

Bulletin No. 211.—Irrigation in Kansas. By Don H. Bark. Pp. 28. Price 10 cents.

This bulletin is one of a series on irrigation in the several arid States, published for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

Bulletin No. 214.—Irrigation in the State of Washington. By O. L. Waller. Pp. 64. Price 10 cents.

This bulletin is one of a series on irrigation in the several arid States, pub-

lished for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

Bulletin No. 215.—Irrigation in New Mexico. By Vernon L. Sullivan, Territorial Engineer. Pp. 42. Price — cents.

This bulletin is one of a series on irrigation in the several arid States, published for the purpose of supplying to intending settlers information as to opportunities for settlement, and the conditions to be met.

CIRCULARS.

*Circular No. 48.—What the Department of Agriculture is Doing for Irrigation. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 4.

*Circular No. 58.—Irrigation in the Valley of Lost River, Idaho. By Albert Eugene Wright, Agent and Expert, Irrigation Investigations, Office of Experiment Stations. Pp. 24.

*Circular No. 59.—Progress Report of Cooperative Irrigation Investigations in California. By S. Fortier. Pp. 23.

*Circular No. 63.—The Work of the Office of Experiment Stations in Irrigation and Drainage. Pp. 31.

This is the testimony of A. C. True, Director of the Office of Experiment Stations, and of Elwood Mead, Chief of Irrigation and Drainage Investigations of the Office, before the Committee on Irrigation of Arid Lands of the United States House of Representatives, at a hearing held February 11, 1905. It is a general statement of the work done by the Office, both as to character and location.

Circular No. 65.—Irrigation from Upper Snake River, Idaho. By H. G. Raschbacher. Pp. 16, fig. 1.

Circular No. 67.—Investigations of Irrigation Practice in Oregon. By A. P. Stover, Irrigation Engineer, Irrigation Investigations, Office of Experiment Stations. Pp. 30, figs. 4.

Circular No. 78.—Progress Report on Irrigation Experiments in Willamette Valley, Oregon. By A. P. Stover. Pp. 25, figs. 7.

This describes experiments in irrigation in the Willamette Valley and gives results of the first season's work.

SEPARATES.

*Document No. 181.—Rise and Future of Irrigation in the United States. By Elwood Mead, Expert in Charge of Irrigation Investigations, Office of Experiment Stations. Pp. iii, 591–612, pls. 5. (Reprint from Yearbook, 1899.)

*Document No. 228.—Some Typical Reservoirs in the Rocky Mountain States. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. iv, 415–430, pls. 8. (Reprint from Yearbook, 1901.)

*Document No. 318.—Preparing Land for Irrigation. By R. P. Teele. Pp. 239–250, pls. 2, figs. 5. (Reprint from Yearbook, 1903.)

Discusses implements, methods, and cost.

*Document No. 349.—Potato Culture near Greeley, Colo. By J. Max Clark. Pp. 311–322, figs. 6. (Reprint from Yearbook, 1904.)

UNIVERSITY OF FLORIDA
3 1262 08928 8152

Document No. 393.—The Relation of Irrigation to Dry Farming. By Elwood Mead, Chief of Irrigation and Drainage Investigations, Office of Experiment Stations, Pp. iv, 423–438. (Reprint from Yearbook, 1905.)

Document No. 458.—The Use of Small Water Supplies for Irrigation. By Samuel Fortier, Chief of Irrigation Investigations. Pp. iii, 409–424, figs. 6. (Reprint from Yearbook, 1907.)

*Document No. 367.—Duty of Water in the Gallatin Valley, Montana. By Samuel Fortier. Pp. ii, 175–196, pls. 2, figs. 3. (Reprint from Bulletin 86 of Office of Experiment Stations.)

Document No. 498.—Irrigation in Utah. By R. C. Gemmell and Geo. L. Swendsen. Pp. iv, 197–218, pls. 12. (Reprint from Bulletin 86 of Office of Experiment Stations.)

Document No. 495.—The Scope and Purpose of the Irrigation Investigations of the Office of Experiment Stations. By Elwood Mead, Irrigation Expert in Charge. Pp. iv, 317–327, pls. 4. (Reprint from Annual Report of Office of Experiment Stations for 1901.)

*Document No. 565.—Review of Irrigation Investigations for 1902. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. iv, 359–385, pls. 6. (Reprint from Annual Report of Office of Experiment Stations for 1902.)

Document No. 670.—Review of Irrigation Investigations for 1903. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. iv, 469–502, pls. 6. (Reprint from Annual Report of Office of Experiment Stations for 1903.)

Document No. 799.—Report of Irrigation and Drainage Investigations, 1904. By Elwood Mead, Chief. Pp. iv, 425–472. (Reprint from Annual Report of Office of Experiment Stations for 1904.)

Document No. 1135.—Losses of Irrigation Water and their Prevention. By R. P. Teele. Pp. iv, 369–386, figs. 4. (Reprint from Annual Report of Office of Experiment Stations for 1907.)

MISCELLANEOUS.

Document No. 723.—Irrigation and Drainage Investigations of the Office of Experiment Stations. By R. P. Teele. Pp. 23, pls. 2.

A general account intended primarily for distribution at the Louisiana Purchase Exposition.

O